Int J Clin Exp Med 2017;10(6):9448-9455
www.ijcem.com /ISSN:1940-5901/IJCEM0051655

Original Article

The short-term effects of discectomy combined with unilateral non-fusion internal fixation for the treatment of lumbar disc herniation

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Received January 15, 2017; Accepted March 18, 2017; Epub June 15, 2017; Published June 30, 2017

Abstract: Objective: To investigate the short-term effect of lumbar disc herniation treated with discectomy combined with unilateral non-fusion internal fixation. Methods: One hundred patients with lumbar disc herniation who were treated from January 2013 to January 2014 were randomly divided into treatment group (50 cases) and control group (50 cases). The treatment group was treated with discectomy combined with unilateral non-fusion internal fixation, and the control group was only treated with discectomy. The operational effects of the two groups were observed, the lumbocrural pain visual analogue scale (VAS), the Oswestry disability index (ODI), the height of involving intervertebral space and the degree of satisfaction were compared between the two groups. Results: The effective rate was 92% in control group and 100% in treatment group (P=0.008). The recorded back pain VAS after the surgery was lower than those before the operation in both groups (P<0.05). Twenty four months after operation, the back pain VAS in treatment group was lower than that in control group (P<0.05). No difference was found between groups on back pain VAS at other time points and on leg pain VAS at each time point after operation (P>0.05). Compared with control group, the ODI in treatment group was lower at 6 and 24 months after operation (P<0.05), and the improvement rate of symptoms in treatment group was significantly higher (P<0.05). At all postoperative time points, the height of involving intervertebral space in control group were obviously higher (P<0.05) and showed a decreasing tendency. The satisfaction rate (96%) of treatment group was significantly higher than control group (82%) (P<0.05). Conclusion: Discectomy combined with unilateral non-fusion internal fixation for the treatment of lumbar disc herniation showed a short-term curative effect. This method had a higher degree of patient satisfaction, better effect of easing the back pain and could maintain the height of involving intervertebral space more effectively compared with pure discectomy. Therefore, it was worthy of clinical promotion.

Keywords: Lumbar disc herniation, discectomy, unilateral non-fusion internal fixation

Introduction

Lumbar disc herniation with a feature of lumbocrural pain is a kind of common orthopedic disease, and it is closely related to the compression and stimulation of peripheral nerve caused by nucleus pulposus protrusion [1]. Discectomy, which is widely used in the treatment of lumbar disc herniation, has an exact effect in alleviating symptoms. After the surgery, however, the intervertebral space becomes narrower, that can reduce the stability between the vertebral bodies, and even cause the recurrence of the lumbar disc herniation. Foreign scholars have suggested that discectomy can be combined with intervertebral fusion in the treatment of lumbar disc herniation at the same time. But intervertebral fusion is difficult to be promoted clinically because it can lead to intervertebral slippage, spinal stenosis and many other problems [2]. In recent years, non-fusion internal fixation is gradually used for the treatment of lumbar disc herniation, and the main difference to the intervertebral fusion is that the mobility of the lumbar spine, on the basis of its stabilization, can be maintained. Currently, the unilateral non-fusion internal fixation combined with discectomy, which is used in the treatment of lumbar disc herniation in foreign countries, has achieved satisfactory results [3]. However, there are few reports in this respect in China. Therefore, this study adopted two therapeutic

methods, discectomy combined with unilateral non-fusion internal fixation and single discectomy, to treat the lumbar disc herniation and then compared their short-term effect.

Materials and methods

General information

One hundred patients diagnosed as single-segment lumbar disc herniation from January 2013 to January 2014, were selected in this study. The research had gained approval from ethics committees and all the patients had provided the informed consents. Inclusion criteria: the patients who aged from 20 to 60 years old, with single-segment lumbar intervertebral discherniation and without medical history of spinal stenosis, intervertebral instability, lumbar surgery and severe facet joint degeneration; the patients were followed up for over 18 months and possessed complete clinical data; the patients who had explicit indication of surgical treatment after normal non-operative treatment, such as invalidation, worse condition or having obvious symptoms of nerve root compression. Exclusion criteria: the patients who had surgical treatment contraindications and severe underlying diseases which made them can't tolerate the surgical treatment; the patients who had other spinal diseases, such as lumbar deformity and spondylolisthesis; and the patients who had lumbar intervertebral disc and couldn't be followed up regularly. Patients were randomly divided into treatment group and control group.

Methods

Treatment group was applied discectomy combined with unilateral non-fusion internal fixation for treatment. The incision was made in the middle of waist after general anesthesia, with the supraspinal and interspinal ligament retained. Then, periosteum was striped to articular process. Intervertebral space was fixed by pedicle screw upper and lower, and facet joint was kept intact. The patients were treated with fenestration decompression, and endorachis in ligamentaflava was detected and cleared away, further removal of a part of the root of spinous process in nerve root was conducted. Then the salient intervertebral disc tissue was detected and then removed, portions of vertebral lamina was cut in order to relieve its compression on nerve root canal. As to the patients with nucleus pulposus herniated or freed from the intervertebral space in the distance, they were treated with half lamina resection discectomy to remove the nucleus pulposus. Fenestration decompression was performed for nucleus pulposus removal in control group. The operative procedures were the same as the treatment group. After the operation, the negative pressure drainage tube was placed and the cut was closed hierarchically.

After the operation, patients of two groups had bed rest for 3-6 days. After the removal of negative pressure drainage tube, they were supposed to carry out functional exercise of low back muscle and do out-of-bed activities with belt protection; besides, they should avoid movements like twist and bow. About one month after operation, they could gradually recover and do normal activity without belt protection. Two groups were followed-up by telephone and re-examination at 3, 6, 12 and 24 months after operation. The loss rate was controlled within 10%.

Outcome measures

VAS was used to score the preoperative and postoperative lumbocrural pain at each time point; ODI was used for evaluating the effect of the disease in patients' ordinary life. Meanwhile, the height of involving intervertebral space (half of the total height of the anterior and posterior margins of the intervertebral space) was measured to assess lumbar vertebrae stability. And the curative effect of two groups was recorded. The number of effective cases included excellent cases and good cases. Evaluation of patients' satisfaction degree was made with a one-to-one satisfaction questionnaire. The answers were classified into three categories: dissatisfaction, satisfaction and great satisfaction.

Statistical analysis

SPSS17.0 was used to deal with the experimental data. Measurement data was presented by mean ± standard deviation ($\overline{x}$ ± SD); comparison between two groups was tested by t-test; comparison for more than two groups was analyzed by one-way ANOVA. Count data was demonstrated as rate and the χ^2 test was applied for its comparison between two groups. Sa-

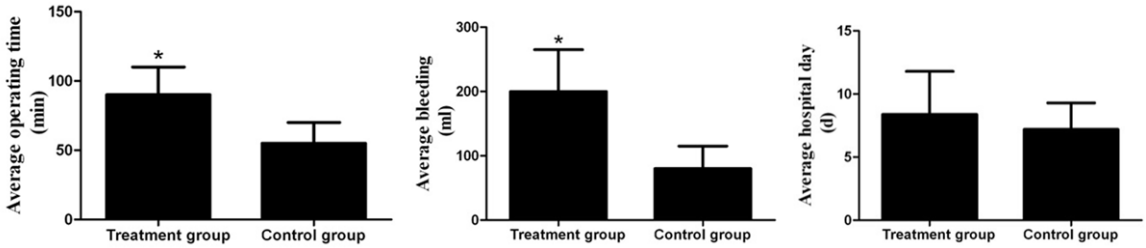

Figure 1. Comparison of patients' average operation time, amount of bleeding and length of stay in the two groups (compared to control group, *P<0.05).

Table 1. The comparison of patients' postoperative clinical curative effect

Group	Case	Excellent (case/rate)	Good (case/rate)	Bad (case/rate)	Effective rate (%)
Treatment group	50	34 (68%)	16 (32%)	0 (0%)	100%*
Control group	50	13 (26%)	33 (66%)	4 (8%)	92%

Note: Compared to control group, *P<0.05.

tisfaction degree and curative effect were ranked data and rank sum test was used to express the comparison of the two groups. P<0.05 was considered statistically significant.

Results

Comparison of general information

There were 50 patients in treatment group, including 27 males and 23 females, aged from 21-35 years, with average age of (36.8±3.5) years, and their disease duration ranged from 2 months to 5 years, with average duration of (7.3±3.7) months. The involved segments included 19 cases of $L_{3,4}$, 18 cases of L_5 S_1, and 13 cases of $L_{3,4}$, and the nucleus pulposus protrusion types included 20 cases of protrusion type, 14 cases of sequestered type and 16 cases of prolapsed-type. There were 50 patients in control group, including 29 males and 21 females, aged from 23-55 years, with average age of (37.2±3.8) years and their disease duration also ranged from 3 months to 5 years, with average duration of (7.5±3.6) months. The involved segments in this group had 17 cases of $L_{3,4}$, 17 cases of L_5 S_1, and 16 cases of $L_{3,4}$, and the nucleus pulposus protrusion types included 18 cases of protrusion type, 15 cases of sequestered type and 17 cases of prolapsed type. The general data comparison between two groups had no statistical difference (P>0.05). The data were comparable.

Operation effects

All patients were performed postoperative follow-up for 20 to 31 months, with an average duration of 25 months. In the treatment group, the operation time was 65 to 115 min, the amount of bleeding was 45 to 250 ml, and the length of stay was 6 to 13 days; there was no postoperative incision infection, and lumbocruralpain was significantly relieved without being aggravated; there were no loosening or breakage of internal fixation, or intervertebral instability in the follow-up period. While in the control group, the operation time was 50 to 100 min, the amount of bleeding was 35 to 110 ml, and the length of stay was 6 to 9 days (**Figure 1**); one case had postoperative cerebrospinal fluid leakage and it was healed after active treatment without incision infection, and lumbocrural pain was obviously relieved without being aggravated; but during the postoperative period from 6 months to 12 months, there were 3 cases with the recurrence of low back pain, one case with radiating pain on lower limbs, and two cases requiring acesodyne to relief pains.

According to statistical analysis, patients' effective rate in control group was 92% and 100% in treatment group, showing that the rate in treatment group was significant higher. The comparison between the groups had statistical difference (P<0.05, **Table 1**).

Preoperative and postoperative lumbocrural pain VAS in the two groups

Compared with preoperative data, the VAS score on low back pain of two groups signifi-

Table 2. The comparison of preoperative and postoperative back pain VAS in the treatment and control group ($\bar{x} \pm s$)

Group	Case	Pre-operation	3 months post-operation	6 months post-operation	12 months post-operation	24 months post-operation
Control group	50	5.35±1.65	2.15±1.52*	2.62±1.34*	2.77±1.43*	2.87±1.25*
Treatment group	50	5.38±1.71	2.18 ±1.49*	2.08±1.62*	2.04±1.38*	1.90±1.36*,#

Note: Compared to the pre-operation, *P<0.05. Compared to control group 24 months after operation, #P<0.05.

Table 3. The comparison of preoperative and postoperative leg pain VAS in the treatment and control group ($\bar{x} \pm S$)

Group	Case	Pre-operation	3 months post-operation	6 months post-operation	12 months post-operation	24 months post-operation
Control group	50	8.76±1.79	2.25±1.61*	2.12±1.47*	2.07±1.71*	2.02±1.15*
Treatment group	50	8.71±1.72	2.17 ±1.52*	2.08±1.51*	2.05±1.68*	2.06±1.24*

Note: Compared to the pre-operation, *P<0.05.

Table 4. Comparison of two groups' preoperative and postoperative ODI ($\bar{x} \pm S$)

Group	Case	Pre-operation	6 months post-operation	24 months post-operation
Control group	50	66.15±12.76	16.72±6.54*	11.38±5.74*
Treatment group	50	65.42±13.85	10.41±4.18*,#	5.61±3.15*,#

Note: compared with preoperative, *P<0.05; compared with control group at alltime points, #P<0.05.

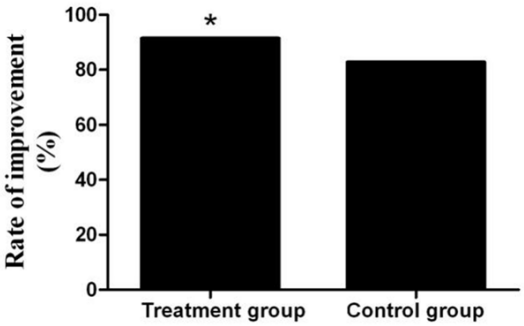

Figure 2. Comparison of effective rates of two groups. Note: compared to control group, *P<0.05.

cantly reduced at 3, 6, 12, 24 months after surgery (P<0.05). However, in the postoperative period, the VAS score in control group gradually increased at each time point (P>0.05), while the VAS in the treatment group gradually decreased (P>0.05). Besides, 24 months after operation, the VAS score in treatment group was significantly lower than that of control group (P<0.05), but the differences in VAS score at other time points showed no statistical significance. In both groups, the differences between patients' postoperative and preoperative leg pain VAS at each time point had statistical significance (P<0.05) while leg pain VAS of the two groups had no significant difference at each postoperative time point (P=0.575), as shown in **Tables 2** and **3**.

Preoperative and postoperative ODI in the two groups

In both groups, patients' ODI scores at 6 and 24 months after surgery, compared to the preoperative ones, were significantly decreased (P<0.05). ODI scores at 6 and 24 months after operation in treatment group were significantly lower than that of control group (P<0.05). While patients' improvement rates at 6 months after operation (84.09%) and 24 months after operation (91.42%) were respectively higher (74.72% at 6 months after surgery, 82.80% at 24 months after surgery) (P<0.05), as shown in **Table 4**; **Figure 2**.

Preoperative and postoperative height of involving intervertebral space of two groups

In the treatment group, the heights of involving intervertebral space at alltime points after the surgery were higher than those before the operation (P<0.05), which were also remarkably higher than those of control group (P<0.05, **Table 5**).

Table 5. The comparison of the changes of the height of involving intervertebral space before and after the operation ($\bar{x}$ ± S, mm)

Group	Cases	Preoperative	3 months after postoperative	6 months after postoperative	12 months after postoperative	24 months after postoperative
Control group	50	9.48±3.44	9.32±3.14	8.18±2.63	6.62±1.87	7.12±2.22
Treatment group	50	9.51±3.39	12.6±3.16*	12.5±3.17*	12.5±2.91*	12.4±3.19*

Note: compared with control group, *P<0.05.

Table 6. Comparison of the satisfaction rate towards patients of two groups

Group	Cases	Dissatisfied (cases/rate)	Satisfied (cases/rate)	Much satisfied (cases/rate)	The rate of satisfaction (%)
Control group	50	9 (18%)	27 (54%)	21 (28%)	82%
Treatment group	50	2 (4%)	17 (34%)	31 (62%)	96%*

Note: compared with control group, *P<0.05.

Comparison of the satisfaction degree towards patients of two groups

Compared with control group, the satisfaction degree in treatment group was remarkably higher (P<0.05, **Table 6**).

Discussion

Discectomy, known as a traditional therapy on lumbar disc herniation, had a certain curative effect; however, it was combined with the risk of intervertebral space narrowing, facet joint degeneration, declined-stability of spinal, recurrent lumbar disc herniation, etc. [4-6]. In the surgical process of discectomy on lumbar disc herniation, the intervertebral fusion, based on the rigid internal fixation, could lead to the loss of motor function during the period of arthrodesis and fasten the process of adjacent segment degeneration. Clinical practice indicated that using intervertebral fusion to cure lumbar disc herniation, based on the elimination of arthrodesis intervertebral disc as well as the loads of small joints, could easily alter the conduction mode of the loads of adjacent segment intervertebral disc as well as small joints, and lead to the troubles such as intervertebral slippage and spinal stenosis and so on [7, 8]. To solve the problems mentioned above, the technique of non-fusion internal fixation was necessarily needed to restrict abnormal loading instead of eliminating it simply. Non-fusion internal fixation, as a non-fusion method of fixation, could restrict the passive range of motion and loads of lumbar disc herniation segments and control the motion segments within the normal range. It also could reduce the loads of intervertebral disc as well as facet joints, playing a significant part in eliminating loads and relieving pain. Studies [9, 10] so far had suggested that unilateral non-fusion internal fixation system could, to the maximum extent, reserve biological function of involved segments, playing an important role in the prevention of low back pain resulted from spinal stability. Additionally, unilateral non-fusion internal fixation could delay the rate of the degeneration of involving intervertebral discas well. In recent years, abundant researches had been done on the technique of unilateral non-fusion internal fixation both domestically and internationally. They coincidentally drew the conclusion that the technique could rebuild the normal mechanical conduction mode of lumbar disc herniation segments and could maintain spinal stability more reasonably [11, 12].

In this study, the treatment group took the treatment of discectomy with the combination of unilateral non-fusion internal fixation, while the control group took single treatment of discectomy. The results showed that both VAS and ODI of the two groups were significantly lower than those before operation, which indicated that both methods could obviously relieve the symptoms of the lumbocrural pain of lumbar disc herniation. The therapy of discectomy was based on the operation of fenestration decompression. Although the operation time was short, with less amount of bleeding and a short-time hospital stay, what was inevitable was that it would cause damage to spinal intervertebral

disc and vertebral lamina, resulting in the reduction of spinal stability. Studies had confirmed that the reduction of spinal stability of patients with lumbar disc herniation after surgery could increase the risk of the collapse of intervertebral disc, deteriorate the condition, and then led to the recurrent lumbar disc herniation [13]. Thus, this study was not only focused on the treatment of discectomy, but also applied discectomy combined with the treatment of unilateral non-fusion internal fixation; the unilateral non-fusion internal fixation system, as a semi-rigid dynamic internal fixation device based on the pedicle screw, played a role in the dynamic fixation. Treatment with discectomy combined unilateral non-fusion internal fixation aimed at avoiding stenosis intervertebral space after discectomy and acceleration of adjacent segment degeneration (ASD) after lumbar spinal fusion [14, 15]. Some studies indicated that the treatment combined the discectomy with unilateral non-fusion internal fixation had a certain effect on the lumbar disc protrusion, however, the unilateral non-fusion internal fixation system would easily bring out the loosening of internal fixation or even fatigue fracture in a long-term stress environment [16]. Nevertheless, in our study, there was no loosening or breakage of internal fixation and intervertebral instability in the follow-up period of patients in the treatment group. And the effective rate of patient in the treatment group was 100% which was remarkably higher than that of control group (92%). Besides, according to the research result, the low back pain VAS of patients who were in the treatment group was apparently lower than that in the control group in the 24 months after operation ($P<0.05$). However, there were no remarkable difference of patients' leg pain VAS between the treatment group and the control group at each time point ($P>0.05$). It showed that the treatment which combined discectomy with unilateral non-fusion internal fixation, had a better effect on treating the lumbar disc protrusion and relieving the low back pain than only using discectomy, which was generally consistent with the previous research results [17].

In our research, lumbocrural pains of patients in the treatment group were remarkably relived and had no aggravation. Meanwhile, there was no loosening or breakage of internal fixation and intervertebral instability during the follow-up period. Whereas in the control group, 3 patients had low back pain recurrences, 1 had lower limbs radiating pain and 2 had pain which had to take acesodyne to relieve in the postoperative 6 to 12 months. Furthermore, the main structure of lumbar spine motion segment was lumbar disc and facet joint. The decline of the intervertebral space height would lead to the acceleration of the intervertebral facet joint degeneration, overstretching of the joint capsule, and the subluxation and synovitis of small joint, which would induce the facet joint-low back pain. In the control group, the height of involving intervertebral space had a declining tendency, which was not found in the treatment group. And the involving intervertebral space was obviously reduced in the control group compared with that in the treatment group which suggested that the recurrence or aggravation of lumbocrural pain after the treatment of lumbar disc protrusion by discectomy only might closely relate with the decline of the intervertebral space height and the further stenosis of intervertebral space. Clinically, the reason for lumbocrural pain of patients with lumbar disc protrusion was diverse, such as the lumbar spinal instability, the denervation and fibrosis of muscular tissue and so on. But all of them were not the reason why the recurrence or aggravation of lumbocrural pain occurred after the treatment of lumbar disc protrusion by discectomy separately [18-20]. It was because the operation of vertebral lamina fenestration and discectomy, with less surgery trauma and lower stripping degrees of musculature, had little influence on the stable structure of the back parts, which further attested to the superiority of discectomy combined with unilateral non-fusion internal fixation. Moreover, in respect of the satisfaction degree survey, patients in the treatment group had a better satisfaction rate of 96% than that of 82% in the control group ($P<0.05$), which also turned out that the treatment which combined discectomy with unilateral non-fusion internal fixation had a more notable effect on treating the lumbar disc protrusion.

Conclusion

In conclusion, discectomy combined unilateral non-fusion internal fixation has a certain short-time effect on treating the lumbar disc protru-

sion. Meanwhile, it can keep the height of involving intervertebral space and has a more significant effect on relieving the low back pain compared with pure discectomy. But there are still some deficiencies in this research, such as the small number of samples and undefined long-term curative effect. Therefore, the curative effect of the treatment combined discectomy with unilateral non-fusion internal fixation need to be further testified by the subsequent experiments with large samples, multicentric and randomized controlled trials.

Disclosure of conflict of interest

None.

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